Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Relict Leopard Frog Monitoring and Management

2014 Annual Report

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

April 2015

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Lower Colorado River Multi-Species Conservation Program

Relict Leopard Frog Monitoring and Management

2014 Annual Report

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[1] Under an agreement with the Lake Mead National Recreation Area, National Park Service, and Nevada Department of Wildlife.

Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
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ACRONYMS AND ABBREVIATIONS

Bd	*Batrachochytrium dendrobatidis* (a pathogenic fungus)
BLM	Bureau of Land Management
CAS	conservation agreement and strategy
Lake Mead NRA	Lake Mead National Recreation Area
NDOW	Nevada Department of Wildlife
NPS	National Park Service
Reclamation	Bureau of Reclamation
RLFCT	Relict Leopard Frog Conservation Team
T^A	ambient air temperature
UNLV	University of Nevada, Las Vegas

Symbols

°C	degrees Celsius
>	greater than
≥	greater than or equal to

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2 Site Assessment of Flag and Cottonwood Springs, Black Mountains, Mohave County, Arizona

EXECUTIVE SUMMARY

This report summarizes efforts under a project designed to implement monitoring, headstarting, and translocation actions described in the voluntary conservation agreement and strategy (CAS) (Relict Leopard Frog Conservation Team [RLFCT] 2005) for the relict leopard frog (*Rana onca = Lithobates onca*). The intent of the CAS is to manage these frogs through a cooperative interagency program to increase both overall numbers as well as number of populations of the species in a defined area of southern Nevada and northwestern Arizona. The methods implemented in this project are specified in a protocol and techniques manual included in the CAS. In general, visual encounter surveys were conducted at all historical and experimental sites known to contain relict leopard frogs. At chosen sites, mark-recapture surveys were conducted to generate population estimates. At these mark-recapture sites, animals captured and those observed but not captured were counted during surveys, with the highest count presented in table 1. To establish new populations and augment existing ones, partial egg masses were collected from historical populations and reared in captive settings to late-stage tadpoles or juvenile frogs. These animals were then released at suitable sites following objectives determined by the RLFCT CAS. Assistance was provided to agency partners to identify potential translocation sites and to conduct associated conservation actions, including assisting with the coordination of the RLFCT meetings. The following information summarizes observations made during monitoring surveys and results from headstarting and translocation actions in 2014. Other conservation actions are also discussed when appropriate.

- Nocturnal surveys were completed at all historical and active experimental sites occupied by relict leopard frogs. The seasonal totals this year were the highest ever recorded (table 1).

- Diurnal surveys were conducted at most sites, with multiple surveys associated with headstarting efforts conducted at several sites.

- Diurnal surveys were not conducted in the Gold Butte area this season because of safety concerns associated with Federal management actions on trespass cattle.

- Partial egg masses were collected for headstarting from sites within the Northshore springs complex and at two sites within the Black Canyon area.

- Translocations of headstarted animals totaled 313 Black Canyon animals released at Lime, Red Rock, and Union Pass Springs; 377 animals from the Northshore springs complex released to Bearpaw Poppy Spring, Horse Spring, and Perkins Pond, with 82 of these animals returned to their place of origin; 54 juveniles transferred to the University of Nevada, Las Vegas, as part of research to assess the impact of an amphibian chytrid fungus on relict leopard frogs; and 7 animals from Black Canyon that escaped from the Willow Beach National Fish Hatchery.

- Small-scale habitat maintenance occurred at Blue Point Spring, Pupfish Refuge Spring, Perkins Pond, and Boy Scout Canyon Spring.

- Storms in September caused minor flooding at various sites, but at Perkins Pond, flash flooding in September damaged the irrigation ditch and intake pipe, leading to a substantial reduction in the pond's water level.

- Site assessments were conducted at Flag and Cottonwood Springs in the Black Mountains of Arizona and at Corn Creek in the Desert National Wildlife Refuge to assess these sites for possible translocations.

INTRODUCTION

Background

The relict leopard frog (*Rana onca = Lithobates onca*) appears to be a narrowly distributed endemic (Jaeger et al. 2001; Oláh-Hemmings et al. 2010). The known historical range of the species includes springs and wetlands along the drainages of the Virgin, Muddy, and Colorado Rivers from the vicinity of Hurricane, Utah, to Black Canyon, below Lake Mead in Nevada and Arizona (Bradford et al. 2004). The species, however, has experienced a reduction in geographic range and number of populations, and taxonomic confusion once led to the declaration that the relict leopard frog was extinct (Jaeger et al. 2001). Historical populations of these frogs now occupy only a few spring sites within two general areas of southern Nevada within the Lake Mead National Recreation Area (Lake Mead NRA). Translocation efforts have established new populations at additional sites (see below).

Conservation efforts for this species began in earnest in the early 1990s, as additional information on population dynamics and distribution was being gathered, including phylogenetic studies. The first interagency meeting focused on the relict leopard frog was held in 1999, and by 2001, a voluntary Relict Leopard Frog Conservation Team (RLFCT) was formed with members from numerous Federal and State agencies (RLFCT 2005). In 2002, the species was petitioned for listing under the Endangered Species Act. Listing was considered warranted but precluded because of conservation efforts by the RLFCT coordinated under a voluntary conservation agreement and strategy (CAS). Recent conservation efforts have focused on monitoring and maintaining existing populations and on attempts to establish experimental populations at additional sites. Despite the success of some conservation efforts, the relict leopard frog remains imperiled.

The information contained herein represents a summary of management, monitoring, and conservation actions implemented by the National Park Service (NPS) and the Nevada Department of Wildlife (NDOW) toward meeting objectives outlined in the CAS. This document represents a final report for field efforts during 2014. Major efforts under this project were performed under the task agreement by personnel at the School of Life Sciences, University of Nevada, Las Vegas (UNLV). Jef Jaeger, at UNLV, was the principle investigator in collaboration with Ross Haley at the Lake Mead NRA and Jon Sjöberg at the NDOW. Other actions conducted by cooperating agencies, such as the Bureau of Land Management (BLM), Bureau of Reclamation (Reclamation), U.S. Fish and Wildlife Service, Arizona Game and Fish Department, and NDOW, as well as staff from the Clark County Desert Conservation Program and the Lower Colorado River Multi-Species Conservation Program, are also summarized when appropriate.

Goal and Objectives

The main goal of the project was the conservation of existing relict leopard frog populations and establishment of new, experimental populations. The main field objectives were as follows:

1. Monitor existing natural populations to assess population persistence and identify potential changes in site conditions that may affect populations

2. Monitor experimental populations to evaluate the success of translocations

3. Identify management actions to improve or mitigate habitat conditions at existing sites to promote persistence of populations and implement small-scale actions or coordinate actions by crews under the guidance of land managers

4. Manage a headstarting program to raise eggs collected from wild frogs to late-stage tadpoles or juvenile frogs for translocation to new sites or to augment existing sites

5. Coordinate efforts to identify new sites for translocations and assist land managers with translocations to these new sites

Reporting Format

The "Results and Discussion" section presented in this document follows a reporting format stipulated by the RLFCT. The format is intended to provide meaningful summaries of actions conducted at each site for seasonal reviews by team members.

METHODS

The methods implemented in this project are specified in the Relict Leopard Frog Protocol and Techniques Manual included in the CAS (RLFCT 2005). The protocols and techniques detail the various procedures used for collecting, rearing, transporting, and releasing frogs and tadpoles associated with headstarting and translocation. Also specified are the methods and timing for monitoring populations.

Site Surveys

In general, visual encounter surveys were conducted at all historical and experimental sites known to contain the relict leopard frog. Surveys were conducted in early spring and again in autumn. All frogs and egg masses observed were counted, but tadpole numbers represent estimates up to 150, after which a greater than symbol (>) is added to indicate larger numbers. All field surveys were conducted by trained biologists with experience in relict leopard frog monitoring and with specific knowledge of survey site characteristics. Diurnal surveys early in the year were used to document breeding activities (egg masses and tadpoles) during a prime breeding period. Nocturnal surveys conducted during spring and autumn were used to better assess numbers of adult frogs; these frogs are more readily observed at night using spotlights when they can be seen in less densely vegetated patches.

Headstarting and Translocations

Early spring diurnal surveys were also used to find and collect eggs for headstarting in the laboratory. The target goals for collection numbers and sites, as well as the targeted sites and actual numbers of late-stage tadpoles or juvenile frogs planned for release, were determined during meetings of the RLFCT. Eggs were processed in a laboratory facility maintained by the Lake Mead NRA. Tadpoles were grown out at this facility, as well as at the Willow Beach National Fish Hatchery; the Lake Mead State Fish Hatchery was not needed this year. Eggs were collected in the wild during February and March, and released as late-stage tadpoles or juvenile frogs from early May through June, and again in August. Headstarted animals were also transferred to UNLV for use in research to determine the susceptibility of relict leopard frogs to the pathogenic fungus *Batrachochytrium dendrobatidis* (*Bd*).

Other Activities

Site visits and assessments were also conducted at several springs to identify and evaluate new potential release sites. In general, identifying potential sites, along with compliance activities, depends largely on land and resource managers. The efforts conducted under this project (including reporting) were aimed at facilitating these actions.

Some habitat maintenance activities were performed or facilitated at important breeding pools. These efforts are noted below along with the habitat activities conducted by collaborating entities.

STUDY AREAS

Eight sites in southern Nevada containing historical populations of relict leopard frogs were monitored during 2014 (figure 1); sites were defined for monitoring purposes and recordkeeping but do not necessarily represent separate demographic units. The historical sites occur in two general areas: in Black Canyon below Hoover Dam and in the Northshore springs complex along the edge of the Muddy Mountains. In addition, 11 active, experimental translocation sites in southern Nevada and northwestern Arizona were surveyed in 2014 (figure 1), and three sites were assessed for potential translocations (see below).

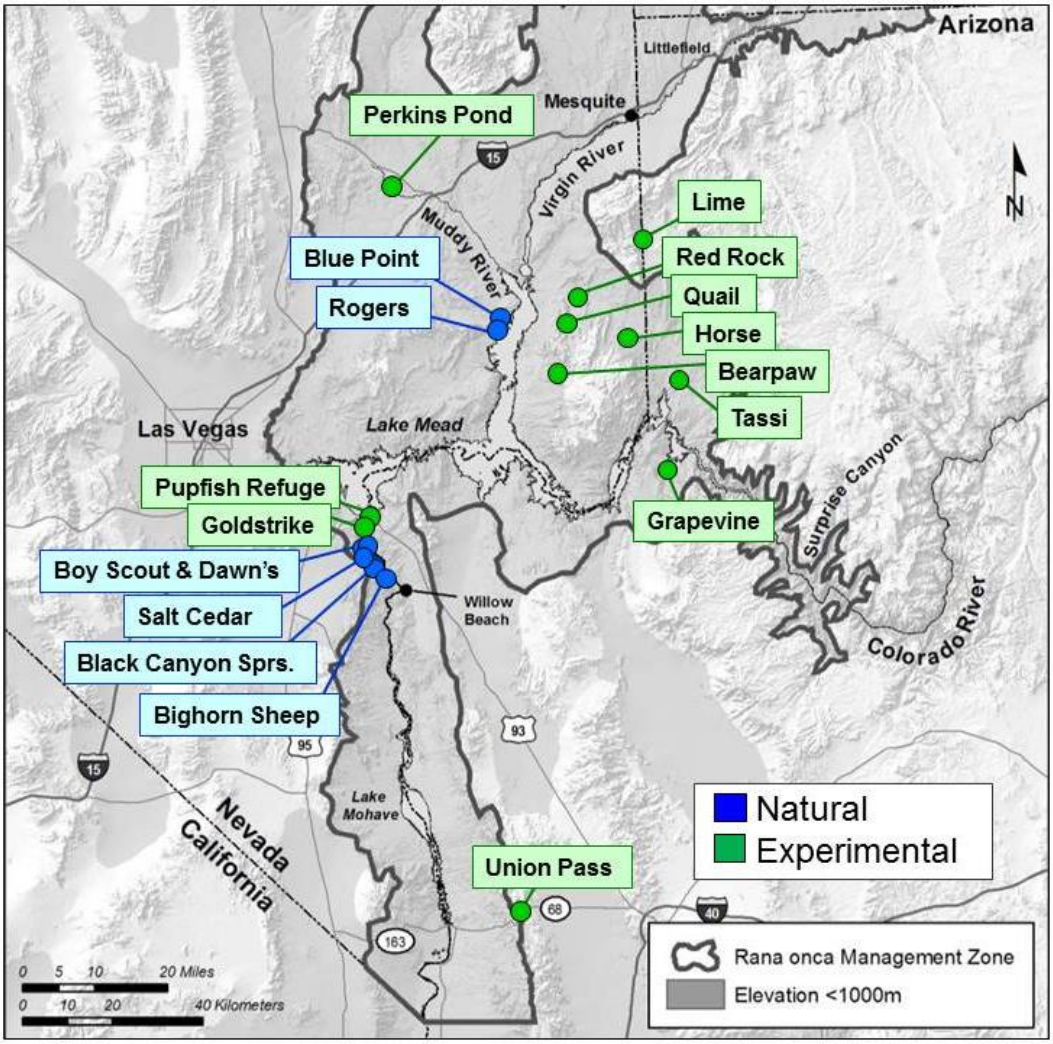

Figure 1.—Locations of sites containing historical populations of relict leopard frogs (in blue) and sites containing active experimental translocation sites (in green).
The potential management zone for the species as identified in the CAS (RLFCT 2005) is indicated, although the area identified in the western Grand Canyon may not be targeted for translocations because of the documented presence of a closely related leopard frog species.

RESULTS AND DISCUSSION

The total number of adult and juvenile relict leopard frogs seen during visual encounter surveys at sites represents a minimum count for the entire species, as not all individuals were detected during the surveys. The count in spring 2014 was 843 frogs, with the count in autumn resulting in a similar number (table 1). The counts in 2014 represent the highest numbers of frogs observed since systematic monitoring was initiated in 2004.

Table 1.—Summary of the maximum number of adult and juvenile relict leopard frogs seen during visual encounter surveys at sites in 2014, with results from 2013 presented for reference

(At some sites in 2013 [indicated by asterisks], multiple mark-recapture surveys were conducted, and the number presented represents the highest count from these surveys.)

Site type	Site	Spring 2013	Autumn 2013	Spring 2014	Autumn 2014
Natural	Bighorn Sheep Spring	29	17	54	11
	Boy Scout Canyon	49	31	36	27
	Dawn's Canyon	6	3	5	6
	Black Canyon Springs	18	19	25	49
	Salt Cedar Canyon Spring	21	39	12	48
	Upper Blue Point Spring	14*	11*	13	14
	Lower Blue Point Spring	11	19	11	17
	Rogers Spring	18	11	3	14
Experimental	Bearpaw Poppy Spring	20	35	51	60
	Goldstrike Canyon	26	15	26	12
	Grapevine Spring, Arizona	125	88	116	150
	Horse Spring	17	11	24	51
	Lime Spring	5	6	15	7
	Pupfish Refuge Spring	39	24	39	26
	Perkins Pond	2	1	1	0
	Quail Spring	154	91	164	76
	Red Rock Spring	7	3	6	20
	Tassi Spring	128	1	107	50
	Union Pass Spring	56	73	135	204
	Totals	**745**	**498**	**843**	**842**

Monitoring of Natural Sites

Bighorn Sheep Spring, Nevada

In autumn 2012, a large number of juvenile frogs were observed that had emerged from temporary pools constructed at the site. The count in spring 2013 appeared to reflect this recruitment event (see table 1). The high count seen in spring 2014 (table 2) may also be a reflection of that recruitment event, although the lower count in fall 2013 is unexplained.

Table 2.—Summary of relict leopard frogs observed at Bighorn Sheep Spring during visual encounter surveys conducted in 2014
(Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/14/2014	17.6	2	0	> 503[a]	13
Diurnal	02/19/2014	25.2	4	0	> 182[b]	22
Nocturnal	04/10/2014	25.2	47	7	97	10
Nocturnal	10/22/2014	26.2	8	3	0	0

[a] Three large tadpoles.
[b] Only 32 confirmed as relict leopard frogs.

Earlier this year, a large number of egg masses were observed within the stream channel, and three partial egg masses were collected for the headstarting program (see table 20). During the nocturnal survey in April, it was noted that vegetation had become denser, and there was less surface water (more intermittent stretches where water was lacking). Tadpoles seen later in the spring appeared to have been from the egg masses observed earlier, indicating sufficient habitat for development. Breeding activity was noted at the site, with calling heard during the two surveys in February and amplexus observed in April.

The much lower count this autumn followed flooding within the canyon prior to the survey. The flooding appeared substantial and caused intermediate habitat alterations. The pools previously occupied by relict leopard frog tadpoles earlier in the year were filled in with sediment or drastically reduced in size. The streamflow was narrower and more intermittent than had been observed in recent years. The flooding removed much of the lower growing vegetation along the channel but left larger trees (tamarisk and mesquite) intact.

Boy Scout Canyon Spring, Nevada

All life stages were observed at this site, as has been commonly reported in recent years (table 3). The high counts in spring and autumn were also similar to counts

Table 3.—Summary of relict leopard frogs observed at Boy Scout Canyon Spring during visual encounter surveys conducted in 2014
(Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	01/25/2014	18.4	1	1	4	1
Diurnal	02/19/2014	21.1	0	0	45	2
Nocturnal	04/15/2014	25.0	35	1	2[a]	0
Nocturnal	10/16/2014	27.0	27	0	4[a]	0

[a] Large tadpoles.

from recent years. A partial egg mass was collected for headstarting during the diurnal survey (see table 20). In January, some minor habitat maintenance was done by UNLV personnel at important breeding pools. By the autumn survey, "Jef's pools" were mostly filled in from recent flooding, and surveyors recommended habitat restoration. In April, it was noted that streamflow had increased substantially into a side channel located low in the system where breeding and recruitment have been observed since 2011. The increased flow appeared to have degraded the side channel as breeding habitat, and no animals were observed in the area during the autumn survey.

Dawn's Canyon Spring, Nevada

Small numbers of frogs were observed during the nocturnal surveys this year (table 4), as has been commonly the case at this small site. No egg masses were observed, but small tadpoles, which were probably relict leopard frogs, were noted in the plunge pool (ending point of surveys) during spring.

Table 4.—Summary of relict leopard frogs observed at Dawn's Canyon Spring during visual encounter surveys conducted in 2014
(Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/19/2014	19.3	0	0	33[a]	0
Nocturnal	04/15/2014	23.1	4	1	1[a]	0
Nocturnal	10/16/2014	29.0	6	0	0	0

[a] Uncertainty of species.

Black Canyon Spring and Black Canyon Side Spring, Nevada

These two areas represent components of the same system, but they are treated as separate sites for reporting. As is usual, the side spring contained most of the frogs observed (table 5). All life stages were observed, and calling was heard during both of the earlier surveys. Small tadpoles observed during February were near the remains of an old relict leopard frog egg mass. During the April survey, robust tadpoles (approximately 7.5 to 10 centimeters long) were observed, which seemed too large to be the same animals observed earlier in the season.

Table 5.—Summary of relict leopard frogs observed at Black Canyon Spring (main channel) and Black Canyon Side Spring during visual encounter surveys conducted in 2014
(Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Site	Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Main stream	Nocturnal	04/17/2014	29.1	3	0	0	0
	Nocturnal	10/16/2014	27.5	5	0	0	0
Side spring	Diurnal	02/14/2014	27.0	1	2	36	0
	Nocturnal	04/17/2014	27.0	13	9	24[a]	1[b]
	Nocturnal	10/16/2014	24.4	37	7	1	0

[a] Thirteen of these were large.
[b] Recently hatched.

Prior to the fall survey, flooding at the side spring removed or flattened emergent vegetation that previously surrounded or filled the pools. Most of the deep pools throughout the site were still intact, with the exception of a large pool at the top of the system, which was filled in with gravel. The frogs observed were concentrated around the remaining pools.

Salt Cedar Canyon Spring, Nevada

The high count from this autumn's survey (table 6) was the highest recorded since monitoring began in 2004 and appears to have been influenced by a large number of young-of-the-year frogs (about half of the adults observed were small adults). This is consistent with the numbers of juvenile frogs and late-stage tadpoles observed at the site earlier in spring. All life stages of relict leopard frogs were seen during spring. Surveyors commented on the high density of emergent vegetation, which likely reduced detectability of relict leopard frogs early in the year, but also noted flooding in autumn that flattened some of the vegetation.

Table 6.—Summary of relict leopard frogs observed at Salt Cedar Canyon Spring during visual encounter surveys conducted in 2014
(Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/14/2014	23.6	4	1	5	2
Nocturnal	04/15/2014	21.6	9	3	18[a]	0
Nocturnal	10/16/2014	25.6	47	1	0	0

[a] All large tadpoles.

Upper and Lower Blue Point Springs, Nevada

Unlike the past several years at Upper Blue Point Spring, mark-recapture was not conducted this year, and the current counts were from standard visual encounter surveys (table 7). Calling was heard during the spring nocturnal survey in numerous locations. The survey conducted in October produced an unusually low count, and a second survey was performed in November. The high counts this year were similar to counts last year (see table 1), but these numbers are approaching half of what was seen at this site in earlier years. Large numbers of frogs were released to this site in 2008, and smaller numbers have been released in 2010, 2013, and 2014 (see table 21 for 2014 releases). A substantial number of diurnal surveys were performed this season to find egg masses as part of the headstarting program. Egg masses were observed in February and March, and part of a small egg mass was collected from the main channel (see table 20).

One of the historical ponds near the road was found to be holding water in November when a frog was heard calling from that area. This area has held water on previous occasions, but it has been dry for some time; the water probably resulted from heavy rains that occurred late in summer. Habitat along the main channel appeared to be declining as emergent vegetation had become denser; this probably also has negatively affected detectability of frogs. In addition, a large pool behind a historical dam in the stream, previously favored by frogs, had been lost as the earthen dam has eroded. There was concern from NPS hydrologist, Geoff Moret, about a drop in the water level. In May, Mr. Moret and personnel from UNLV visited the spring to evaluate the monitoring station.

Even though there were minor vegetation reduction efforts conducted along the stream in November 2013, the vegetation had mostly filled back in by the time surveys began this year. By August, pools previously created outside of the main channel had also become densely packed with vegetation. About 55 linear meters of vegetation was again cut along intermittent portions of the system in November of this year by personnel from UNLV, NDOW, and BLM.

Table 7.—Summary of relict leopard frogs observed at Upper and Lower Blue Point Spring during visual encounter surveys conducted in 2014
(Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Site	Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Upper	Diurnal	02/05/2014	17.1	2	0	0	0
	Diurnal	02/08/2014	21.2	0	0	0	0
	Diurnal	02/11/2014	20.6	0	0	0	0
	Diurnal	02/20/2014	19.2	0	0	0	2[a]
	Diurnal	02/26/2014	27.0	0	0	0	0
	Diurnal	03/04/2014	20.3	0	0	0	1
	Nocturnal	03/20/2014	13.4	13	0	0	0
	Diurnal	08/11/2014	36.5	0	0	0	0
	Nocturnal	10/20/2014	22.8	3	3	0	0
	Nocturnal	11/09/2014	17.2	9	5	0	0
Lower	Diurnal	02/05/2014	17.4	0	0	0	0
	Diurnal	02/08/2014	23.2	1	2	0	0
	Diurnal	02/11/2014	20.5	0	0	0	1
	Diurnal	02/20/2014	19.6	0	0	34	1
	Diurnal	02/26/2014	23.8	0	0	45[b]	0
	Nocturnal	04/16/2014	20.1	8	3	4	0
	Diurnal	05/07/2014	23.9	0	0	0	0
	Diurnal	08/11/2014	42.2	1	0	0	0
	Nocturnal	10/20/2014	19.5	16	1	0	0

[a] Already hatched.
[b] Uncertain of species for five tadpoles.

At Lower Blue Point Spring, the counts this season were comparable to the counts in 2013 (see table 1). Juveniles observed earlier this year were likely natural recruits from the egg mass and tadpoles observed last year; no animals from the headstarting program were released to the site last year. All life stages of relict leopard frogs were again observed this year (see table 7), and part of an egg mass was collected for headstarting (see table 20). The juvenile frog seen in October, however, was most likely one of the animals released in May or August (see table 21 for 2014 releases). Calling by relict leopard frogs was heard in February and August.

Habitat efforts in February and November at Lower Blue Point Spring were conducted by personnel from UNLV. Efforts were directed at the intake pipe to the fish-free pond as well as further downstream where burros had trampled vegetation in autumn 2012 and an egg mass was observed in spring 2013 and after vegetation removal this year. In February, the fish-free pond was free of vegetation, except for the perimeter, but water inflow was minimal. Water flow was improved by removing roots and sediment entwined in the pipe's intake screen. Downstream from the intake pipe, vegetation was reduced along 6 linear meters of the main channel, and five small pools (1 x 1 meter) were created adjacent to the channel. By April 16, the main stream appeared channelized, and the pools created in February had little water or were dry. Water flow also had again become reduced to the fish-free pond, but the pond contained large tadpoles from egg masses hatched earlier this season. The intake pipe was cleared again, and the water level quickly rose in the pond. In early October, the pipe was cleared again, but in the span of a month between visits in autumn, the fish-free pond had dried out almost completely. As has been noted before, frequent visits appear to be necessary to keep the intake pipe clear to maintain the fish-free pond and allow tadpole development. In November, approximately 19 linear meters of emergent vegetation was reduced along intermittent portions of the stream near the intake pipe, and further downstream, and in a few of the existing pools (created in February).

Rogers Spring, Nevada

The nocturnal survey in spring was negatively affected by unfavorable weather conditions prior to the survey, predominately winds as high as 40 kilometers per hour the night before. Although a few frogs were observed, relict leopard frogs were heard calling. The count in autumn was consistent with numbers observed in recent years (see table 1). All life stages of relict leopard frogs were observed this year (table 8), and a portion of an egg mass was collected in February for headstarting (see table 20). Juvenile frogs observed in autumn were most likely the animals from the headstarting program that were returned to the site in August (see table 21).

Table 8.—Summary of relict leopard frogs observed at Rogers Spring during visual encounter surveys conducted in 2014
(Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/05/2014	11.8	0	0	0	0
Diurnal	02/11/2014	16.9	1	0	0	1
Nocturnal	03/27/2014	14.5	3	0	38	0
Diurnal	08/12/2014	33.0	1	0	0	0
Nocturnal	10/13/2014	18.7	11	3	0	0

Habitat conditions for relict leopard frogs at this site remain relatively poor, with dense vegetation covering the majority of the system. As in the recent past, frogs were only observed at, or just above, the power line road where some open habitat remains. Vegetation, however, has encroached into the open area of the stream.

Monitoring of Experimental Sites – Black Canyon

Goldstrike Canyon, Nevada

The counts at this site this year (table 9) did not reflect the release of 111 frogs and 5 tadpoles to the site in June and October 2013; although, the smaller adults observed in spring were probably some of the animals released to the site last year. Egg masses were observed at the usual side pool low in the system during both February and April, and large tadpoles were observed within this pool in October. The storm that caused flooding at other sites in the canyon prior to autumn surveys appeared to have altered the main channel in the lower section of the system and had returned water flow to the important side pool, which may improve recruitment at this site.

Table 9.—Summary of relict leopard frogs observed at Goldstrike Canyon during visual encounter surveys conducted in 2014
(Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/24/2014	19.3	2	0	21	1
Nocturnal	04/09/2014	28.0	20	6	1[a]	1[b]
Nocturnal	10/18/2014	27.8	12	0	9[a]	0

[a] Large tadpole.
[b] Recently hatched.

Pupfish Refuge Spring, Nevada

The counts this year were similar to the counts last year (see table 1), and all life stages of relict leopard frogs were again observed (table 10), along with calling, in April. Surveyors noted that some frogs appeared "skinny," although plenty of insects were present. Vegetation density has increased along the main channel and drainage ditch along Portal Road. Vegetation management was not conducted last year, as had occurred over the last several years, and the main breeding pool at the base of the drainage ditch has been filling in with cattails (*Typha* sp.). The water flow in the drainage ditch also appears to have declined this year. Despite these issues, all but one of the egg masses seen this season were in pools along the drainage ditch, as were all the large tadpoles and all but one of the juvenile frogs. A biologist from Reclamation reported two other egg

Table 10.—Summary of relict leopard frogs observed at Pupfish Refuge Spring during visual encounter surveys conducted in 2014
(Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/25/2014	22.9	4	0	26	2
Nocturnal	04/07/2014	24.9	35	4	9[a]	4
Nocturnal	10/08/2014	28.7	21	5	2	0

[a] Observed two overwintered tadpoles.

masses at the main breeding pool early in February (these were not the egg masses recorded in table 10). Maintenance of breeding pools along the drainage ditch was conducted by Reclamation, NDOW, and UNLV personnel on December 15. Approximately 38 linear meters of emergent vegetation was removed.

Monitoring of Experimental Sites – Gold Butte Area

Diurnal surveys were not conducted at sites located within the Gold Butte area this year mostly because of safety issues associated with a controversial roundup of trespass cattle organized by Federal agencies that occurred in April. Because higher counts are generally made during nocturnal surveys, this likely did not affect the minimum observation numbers found. For monitoring purposes, emphasis was placed on conducting nocturnal surveys in March, prior to the roundup, with the exception of Lime Spring, which is at high elevations and was surveyed successfully late in the season.

Quail Spring, Nevada

Since 2010, the number of relict leopard frogs occupying this small site has been quite large, with spring season counts usually > 100 frogs. The count this spring was no exception (table 11). Two surveys were conducted this autumn because of the initially low number counted, but the count later in the season was much lower. During the nocturnal survey in March, no egg masses were obvious, but there were numerous juveniles. Large tadpoles were documented during the autumn surveys. The last translocation to this site was in 2012; thus, the juveniles observed this year likely represented the first documentation of natural recruitment at this site (one of the measures of success for translocation sites). Calling by relict leopard frogs was heard in March and November.

Evidence that cattle had been grazing cattails in the main pool was found in October. Cattle and burro grazing around and within the pool maintains this

Table 11.—Summary of relict leopard frogs observed at Quail Spring during visual encounter surveys conducted in 2014
(Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Nocturnal	03/25/2014	18.8	127	37	13[a]	0
Nocturnal	10/04/2014	23.2	76	0	1[b]	0
Nocturnal	11/10/2014	20.7	31	3	4[b]	0

[a] Overwintered tadpoles.
[b] Large tadpoles.

system from being overrun with emergent vegetation. As seen previously, the lower pool this March contained a high density of dragonfly larvae, which are known to consume tadpoles.

Red Rock Spring, Nevada

Although the initial 5 years of augmentation at this site was completed in 2010, the site was used to release excess headstarted Black Canyon animals in 2013 and again 2014. The smaller adults, juveniles, and tadpoles observed this year were most likely the animals from those releases (table 12). The higher count in autumn followed the release of 163 animals this year. The initial count in March did not reflect the release of 30 frogs in 2013, but the temperature (8.1 °C) was well below that commonly recorded for relict leopard frog surveys and followed strong winds for 2 days prior. The poor survey conditions in spring were also evidenced by the absence of the red-spotted toad (*Bufo punctatus = Anaxyrus punctatus*), which is usually recorded during the spring surveys at this site. Despite the cooler air temperatures, calling by relict leopard frogs was heard. Surveys conducted prior to releases in June resulted in the documentation of a few more frogs.

Table 12.—Summary of relict leopard frogs observed at Red Rock Spring during visual encounter surveys conducted in 2014
(Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Nocturnal	03/19/2014	8.1	3	0	0	0
Nocturnal	06/03/2014	21.3	6	0	0	0
Diurnal	06/12/2014	40.0	3	1[a]	0	0
Diurnal	08/09/2014	36.2	3	1	1	0
Nocturnal	10/04/2014	16.2	17	3	0	0

[a] Metamorph.

Water flow had declined by early June, and flow to the waterfall pool and "mud pools" higher in the system had ceased, although these deep pools still held water. During the August visit, there was evidence of previous minor flooding, but water flow had not improved, and water quality in the stagnant pools was turbid. By October, there was a trickle of water flowing into the waterfall pool, but the main "mud pool" was dry; this was the only pool at this site where late-stage wild tadpoles were observed and speculated to have metamorphosed. A dead Woodhouse's toad (*Bufo woodhousii= Anaxyrus woodhousii*) was found in the waterfall pool in August, with no sign of physical trauma.

Tassi Spring, Arizona

Last autumn, only a single frog was observed at this site (see table 1), but during the spring survey this year, a large number of relict leopard frogs representing all life stages were again observed, including large adults (table 13). Relict leopard frog calling was also heard. Such large swings in the number of frogs observed between spring and autumn at this site has been previously documented twice (2009 and 2010). These changes may be associated with weather patterns at this site that prompt frogs to become less active. The autumn count this season, although low, was much higher than last year. There was an attempt to conduct the autumn survey much earlier this year; however, heavy rains at that time had washed out the road.

Table 13.—Summary of relict leopard frogs observed at Tassi Spring during visual encounter surveys conducted in 2014
(Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Nocturnal	03/28/2014	17.2	103	4	11[a]	4[b]
Nocturnal	10/11/2014	26.6	47	3	> 2,200[c]	0

[a] Observed 10 overwintered tadpoles.
[b] Two of these egg masses hatched recently.
[c] Approximately 2,000 were hatchlings from four spent egg masses.

Sometime in early spring, the NPS reduced the vegetation in the drainage channel below the springhead. The majority of the cattails within the channel and near the springhead were cut, tied in bundles, and laid along the channel bank. By autumn, cattails were again growing dense within and along the drainage ditch. Flooding from heavy rains in September, however, scoured the lower portion of the stream within the large wash. The storm also completely filled in the horse trough with sediment where all life stages of relict leopard frogs had been commonly seen in the past.

Lime Spring, Nevada

The number of frogs observed this spring (table 14) was more than twice that counted during surveys at this site last year (see table 1). This site was initiated in 2012, and translocations continued this year (see table 21). The juvenile seen this year was measured at 45-millimeter snout-to-vent-length and probably was a slow-growing frog from releases last year. In early May, hatchlings of unknown species were found in a pool occupied by three adult relict leopard frogs, but a search for remains of old egg casings was unsuccessful, and two other anuran species occur at this site.

Table 14.—Summary of relict leopard frogs observed at Lime Spring during visual encounter surveys conducted in 2014
(Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Nocturnal	05/16/2014	19.3	14	1	0	0
Diurnal	05/30/2014	26.1	4	0	0	0
Nocturnal	09/25/2014	20.3	7	0	0	0

Evidence of cattle use was observed during all surveys, and emergent vegetation along the stream channel was well grazed in places. Observations from earlier surveys noted that the spring flow ended at the old cattle trough and was intermittent in several places upstream. During the diurnal survey in May, surveyors moved about 200 meters above the usual upstream ending point to look for permanent surface water, but only damp soil was found. By September, surface water was greatly reduced, limiting suitable habitat to less than 50 linear meters. All frogs observed at this time occupied a single, small shallow pool (approximately 2 x 0.5 meters). This observation raises the question as to whether there is sufficient surface water at this site to sustain a population over the years.

Horse Spring, Nevada

The number of frogs counted at this site has increased since the first translocations in 2012, and the number observed in autumn (table 15) was more than double that observed in 2013 (see table 1). Although all life stages of relict leopard frogs have been recorded, large tadpoles and juvenile frogs have been released at this site (see table 21 for 2014 release data); thus, natural recruitment has not yet been determined. Again this season, relict leopard frogs were heard calling in March and June.

Table 15.—Summary of relict leopard frogs observed at Horse Spring during visual encounter surveys conducted in 2014
(Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Nocturnal	03/26/2014	19.0	20	4	6[a]	1
Diurnal	06/03/2014	25.3	15	7	0	0
Nocturnal	09/23/2014	20.4	45	6	21	0

[a] Overwintered tadpoles.

A biologist from the BLM visited the site in early February and observed very large tadpoles and two egg masses; the tadpoles were probably overwintering animals from releases the previous spring. In spring, the main pool had grown dense with emergent vegetation (mainly reed cannery grass and cattails), but cattle appear to have reduced much of the grass by autumn.

Bearpaw Poppy Spring, Nevada

This site was initiated by translocations in 2012, and counts this year (table 16) are more than double from last year (see table 1). The juveniles and small adults observed were all likely animals from the releases (thus, they do not reflect natural recruitment). Translocations continued this year and have included late-stage tadpoles for the first time (see table 21). Calling by relict leopard frogs were heard during the March survey.

Table 16.—Summary of relict leopard frogs observed at Bearpaw Poppy Spring during visual encounter surveys conducted in 2014
(Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Nocturnal	03/16/2014	19.5	46	5	0	0
Diurnal	06/11/2014	35.6	1	0	0	0
Nocturnal	10/02/2014	20.7	55	5	0	0

Vegetation throughout the stream channel was well grazed by burros, with the exception of areas within the exclusion fence around the springhead. Minor flooding from storms in September resulted in sedimentation of the artificial pools created in 2012.

Monitoring of Experimental Sites – Other Sites

Perkins Pond, Nevada

Earlier this year, overwintering by relict leopard frogs was documented for the second time at this site (table 17), although only a single animal was documented. During all nocturnal surveys this year, a bullfrog (*Rana catesbeiana = Lithobates catesbeianus*) was either observed in the pond or heard calling. Translocations of relict leopard frogs to this artificial pond continued this year (see table 21), but this was the fifth and final year for scheduled translocations at this site.

Table 17.—Summary of relict leopard frogs observed at Perkins Pond during visual encounter surveys conducted in 2014
((Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/13/2014	14.6	0	0	0	0
Nocturnal	04/24/2014	16.0	0	0	0	0
Nocturnal	05/01/2014	15.4	1	0	0	0
Diurnal	06/20/2014	36.7	0	0	0	0
Nocturnal	10/03/2014	19.0	0	0	0	0
Nocturnal	10/27/2014	20.1	0	0	0	0

Maintenance of the bullfrog exclusion fence that surrounds the pond has not kept vegetation from entangling large portions of the fence line, although early in the year, personnel from the Clark County Desert Conservation Program cut vegetation from a small portion of the fence. In March, NDOW personnel installed a new intake pipe within the irrigation ditch, burying it for protection. Flooding from a storm in April, however, exposed and damaged a portion of the pipe. While the pipe was being repaired, the water level in the pond decreased by about 1 meter. Heavy rains in September caused two major flooding events and again damaged the pipe and undermined the cement irrigation ditch. On September 29, water was shut off to the pond, and since then, the water level has been decreasing substantially, exposing much of the pond liner.

Grapevine Spring (Meadview Area), Arizona

The high counts this year were consistent with results from last year (see table 1) and in previous years. As usual, all life stages of relict leopard frogs were observed (table 18), and calling was heard during the diurnal survey. Vegetation density has increased throughout the system since the last major flooding event in

Table 18.—Summary of relict leopard frogs observed at Grapevine Spring during visual encounter surveys conducted in 2014
(Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	03/07/2014	20.8	28	0	2[a]	11
Nocturnal	05/14/2014	21.4	113	3	18[b]	2[c]
Nocturnal	10/17/2014	21.4	143	7	11	0

[a] One overwintered and one large tadpole.
[b] All large.
[c] The remains of spent egg masses.

November 2010, hindering detectability during surveys. Before the autumn survey, however, flooding at the site reduced emergent vegetation within portions of the stream, likely improving habitat for relict leopard frogs.

Union Pass Spring, Black Mountains, Arizona

The counts of frogs at this site have increased strikingly since translocations began in 2011. Augmentations continued this year (see table 21). All life stages of relict leopard frogs were again observed this spring (table 19), and egg masses were found throughout much of the system. Natural recruitment into the adult population, however, cannot yet be confirmed because of the continued releases of tadpoles and juvenile frogs.

Table 19.—Summary of relict leopard frogs observed at Union Pass Spring during visual encounter surveys conducted in 2014
(Also provided is the ambient air temperature [T^A] in degrees Celsius [°C] during the survey).

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/27/2014	23.3	20	0	37[a]	42
Nocturnal	05/02/2014	20.0	133	2	49[b]	0
Diurnal	05/08/2014	25.4	20	0	16[b]	0
Nocturnal	10/05/2014	23.6	190	14	10	0

[a] Thirteen of these likely overwintered.
[b] All large.

There has been expansion of the area used by relict leopard frogs downstream well past sites of release, and early in the year, a frog was found in the lower, intermittent stream not far from the highway. During the autumn survey,

observers saw an adult frog that could not right itself or jump properly. Although there was no obvious external physical damage, surveyors speculated that the frog may have been stepped on, either by one of the survey team or by a cow or burro, which were in the system at that time.

Other Monitoring Actions

Site Assessments

Surveys were conducted to assess habitat conditions for potential translocation of relict leopard frogs at Corn Creek in the Desert National Wildlife Refuge in Nevada in April and at Flag and Cottonwood Springs in the Black Mountains of Arizona in June. Several members of the RLFCT visited these sites, and reports of these surveys are found at the end of this report (see attachments 1 and 2). In general, the consensus of the biologists present at Corn Creek was that the system warranted further consideration and potential planning for introduction. The consensus of the group conducting the assessment of Flag and Cottonwood Springs was that there appeared to be sufficient permanent surface water and habitat to support relict leopard frogs. There was, however, permitting issues associated with the spring sites being on patented (private) lands that need to be considered.

Headstarting and Translocations

Collections

In total, seven partial egg masses were collected this year for the headstarting program, with four of these from the Black Canyon area and the others from the Northshore springs complex (Blue Point and Rogers Springs) (table 20). A greater variety of egg masses were targeted this year because of the need for diversity in frogs for use in the *Bd*-challenge study being conducted at UNLV. All egg masses collected contained viable eggs that were reared initially at the NPS facility at Hilltop. Some Black Canyon tadpoles were later (on April 2) moved to tubs at the Willow Beach National Fish Hatchery.

Table 20.—Collection sites and dates partial egg masses of relict leopard frogs were collected for headstarting and translocation in 2014

Area	Site	Date	Partial egg masses
Black Canyon	Bighorn Sheep Spring	02/14/2014	2 (small, 1/4 collected)
	Bighorn Sheep Spring	02/19/2014	1 (small, 1/4 collected)
	Boy Scout Spring	02/19/2014	1 (small, 1/4 collected)
Northshore	Upper Blue Point Spring	03/04/2014	1 (small, 1/2 collection)
	Lower Blue Point Spring	02/11/2014	1 (small, 1/2 collection)
	Rogers Spring	02/11/2014	1 (small, 1/4 collected)

Translocations

A total of 751 animals (358 late-stage tadpoles and 393 juvenile frogs) were produced from the egg masses collected. Of these, 690 animals (356 late-stage tadpoles and 334 juvenile frogs) were released to 6 experimental sites or back to 3 historical sites (table 21). In addition, 7 animals collected from eggs in Black Canyon escaped from the Willow Beach National Fish Hatchery in Black Canyon (see below), and 54 juvenile frogs (27 from Black Canyon and 27 from Northshore) were transferred to UNLV for research purposes.

Table 21.—Numbers of late-stage tadpoles and post-metamorphic frogs raised from eggs collected in Black Canyon or the Northshore springs complex and released at sites in 2014 (Years when experimental sites first received translocations are indicated parenthetically after the site name.)

Stocks	Translocation site	Date	Tadpoles	Juveniles	Event totals
Black Canyon	Lime Spring (2012)	05/30/2014	21	30	51
	Red Rock Spring (2005)	06/03/2014	30	25	55
		06/12/2014	29	10	39
		08/09/2014	0	69	69
	Union Pass Spring (2011)	05/08/2014	99	0	99
	Cumulative subtotal		179	134	313
Blue Point	Bearpaw Poppy Spring (2012)	06/11/2014	30	56	86
	Horse Spring (2012)	06/03/2014	30	19	49
	Lower Blue Point Spring	05/07/2014	0	15	15
		08/11/2014	0	25	25
	Perkins Pond (2010)	05/01/2014	90	30	120
		06/20/2014	27	13	40
	Rogers Spring	08/12/2014	0	22	22
	Upper Blue Point Spring	08/11/2014	0	20	20
	Cumulative subtotal		177	200	377
		Column totals	356	334	690

Sites that received Black Canyon animals included Lime, Red Rock, and Union Pass Springs. Union Pass Spring appears crowded with relict leopard frogs, but the release was conducted to increase potential genetic diversity. There was an excess of Black Canyon animals again this year, and these were released to

Red Rock Spring. Sites that received Northshore springs complex animals were Bearpaw Poppy Spring, Horse Spring, and Perkins Pond. Many Northshore animals were also returned to their respective sites of origin.

Hatchery Issues

The Lake Mead State Fish Hatchery was not used this year because of the limited need for animals. At the Willow Beach National Fish Hatchery, the raceway used in the past was not available, and instead, two smaller tubs were used (61 x 100 x 18 centimeters). These tubs had been previously used to test water quality on relict leopard frog tadpole development. Initially, 80 Black Canyon tadpoles were brought to the hatchery, but 2 tadpoles escaped down a drain during acclimation. The tubs were close to windows, and a full spectrum light on a 12-hour day/night cycle was placed above. Feeding protocol followed that used at Hilltop, and food was supplied from common stocks. No deaths were documented, but some tadpoles appeared abnormally "skinny."

The first metamorphs were collected on May 3, and additional metamorphs were observed on May 11; but, by May 13, when personnel arrived to remove these juvenile frogs, they had escaped from the tubs. All remaining tadpoles were returned to Hilltop at that time. In retrospect, the tubs should have been fitted with screened lids to keep the frogs from escaping. As per protocol, only Black Canyon animals were housed at the Willow Beach National Fish Hatchery because of the potential for escape. Adult relict leopard frogs have been observed at the hatchery in the past, likely coming from sites upriver, including one marked frog believed to have come from Bighorn Sheep Spring.

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ATTACHMENT 1

Site Assessment of Corn Creek, Desert National Wildlife Refuge, Clark County, Nevada

Surveyors: Jef Jaeger and Rebeca Rivera (report authors; University of Nevada, Las Vegas) and Michael Burroughs (U.S. Fish and Wildlife Service)

Date and Time of Surveys: April 23, 2014; 18:50–19:35 (diurnal) and 20:05–20:50 (nocturnal)

Environment Conditions (recorded at end of nocturnal survey):

Water temperature near the eastern-most springhead: 21.3 degrees Celsius (°C)
Ambient air temperature: 18.8 °C
Relative humidity: 21.8 percent
Cloud cover: 0–20 percent

SURVEY OBJECTIVE

A site visit was conducted to assess habitat conditions at Corn Creek for potential translocation of the relict leopard frog (*Rana onca = Lithobates onca).*

SURVEY DETAILS

The spring is located near the visitor's center of the Desert National Wildlife Refuge managed by the U.S. Fish and Wildlife Service. The system has been recently modified with paved paths and other infrastructure for visitors. Two large springheads were observed that flowed a short distance (figure 1) to eventually join at a large, cement lined-reservoir (figure 2); an egret was seen stalking within the cement reservoir. Small unidentified fish were observed to occupy the stream (figure 3). From the reservoir, there was a main stream with a secondary, minor stream to the north (the latter flows below the poolfish refugium). Much of the system was covered by large trees, predominately cottonwoods (*Populus* sp.) and willows (*Salix* sp.), among others. There were long stretches of the stream not covered in dense, emergent vegetation that would make good habitat for adult relict leopard frogs (figures 4 and 5). Lower in the system, both streams eventually braid (figure 6) and end in dense, emergent vegetation (particularly *Typha* sp.) (figure 7).

The recent habitat restoration appeared to have greatly reduced bullfrog (*Rana catesbeiana = Lithobates catesbeianus*) numbers in the system; in the late 1990s, over 100 bullfrogs were encountered during surveys. Only three large bullfrogs were encountered during the current survey. Large Woodhouse's toads (*Bufo woodhousii = Anaxyrus woodhousii*) were numerous (46 counted). Crayfish (likely *Procambarus* sp.) were found in high abundance in the stream near the

springheads, but their abundance appeared to dwindle lower downstream (well below the reservoir). The presence of crayfish, however, would undoubtedly have a negative impact on relict leopard frog reproduction.

SURVEY CONCLUSION

The consensus of the biologists present was that the system warranted further consideration and potential planning for relict leopard frog introduction. The presence of bullfrogs and crayfish are negative factors toward the success of the translocation. Bullfrogs should be targeted for removal. The presence of *Batrachochytrium dendrobatidis* should be assessed prior to release of relict leopard frogs.

Figure 1.—A stretch of stream below the eastern springhead, located above the reservoir. Cattails (*Typha* sp.) had been pulled along this section of stream. Large numbers of crayfish and small fish were observed.

Figure 2.—Cement-lined reservoir.

Figure 3.—Small fish found in stream above reservoir.

Figure 4.—Open segment of stream below reservoir showing large trees shading the stream.

Figure 5.—Open segment of stream below reservoir.

Figure 6.—The main channel located near the base of the system. Dense, emergent vegetation covers the streambanks.

Figure 7.—A marshy area located at the base of the system. Dense, emergent vegetation covers the water.

ATTACHMENT 2

Site Assessment of Flag and Cottonwood Springs,
Black Mountains, Mohave County, Arizona

Surveyors: Jef Jaeger and Rebeca Rivera (report authors; University of Nevada, Las Vegas), Tyler Coleman and Mike Sredl (Arizona Game and Fish Department), Rebecca Peck (Bureau of Land Management-Arizona), and Dave Bradford

Date and Time of Survey: June 8, 2014; 09:30–11:30 (diurnal)

Environment Conditions (recorded at end of survey):

Water temperature at Flag Spring: 25.1 degrees Celsius (°C)
Ambient air temperature: 33.7 °C
Relative humidity: 12.9 percent
Cloud cover: 0–20 percent

SURVEY OBJECTIVE

The survey was intended to assess summer, pre-monsoonal conditions at Flag and Cottonwood Springs for possible translocation of the relict leopard frog (*Rana onca = Lithobates onca*). A previous survey by Tyler Coleman was conducted on January 23, 2014.

SURVEY DETAILS

The survey crew used utility terrain vehicles to access the canyon up to about the wilderness boundary (739108, 3883270, Zone 11S, WGS84), with the spring sites accessed on foot. Cottonwood Spring was surveyed first, and the team worked upstream to Flag Spring.

At the time of the survey, the canyon contained three watered areas: Cottonwood Spring, lower in the canyon (739119, 3883357); Flag Spring, at the upper end of the canyon (739792, 3884648); and a watered area between the two springs. Parts of Flag and Cottonwood Springs are on patented (private) lands, although neither of the sites were fenced or posted.

Cottonwood Spring consisted of ≥ 250 meters of aquatic habitat, with emergent and riparian vegetation covering most of the current length. Cottonwood Spring had cement barriers that were part of an old water diversion. There were several broad, deep pools (figures 1–3). Flag Spring was smaller and consisted of about 75 meters of aquatic habitat, with several deep pools in bedrock (figures 4 and 5). Flows at both springs were estimated at approximately 38–76 liters per minute, with an aquatic width of about 1–3 meters and a riparian width of approximately 3–5 meters. The watered area located between Flag and Cottonwood Springs consisted of approximately 50 meters of aquatic habitat.

The spring sites supported several tree species, including two species of willow (*Salix gooddingii and S. exigua*), cottonwood (*Populus fremontii*), desert willow (*Chilopsis linearis*), and oak (*Quercus* sp.). Tree cover was not substantial. Emergent vegetation included cattail (*Typha* sp.), monkey flower (*Mimulus* sp.), Arizona canyon grape (*Vitis arizonicus*), sedges (probably *Eleocharis* sp.), and at Flag Spring, a patch of tall reed (possibly *Phragmites* sp.). The canyon had recently experienced a flood that had removed much vegetation; the event occurred sometime in 2013 (according to Tyler Colman who had communications with Jeff Pebworth, Arizona Game and Fish Department, who had noted the change).

The red-spotted toad (*Bufo punctatus* = *Anaxyrus punctatus*) was observed at Cottonwood Spring. Two adult toads, a juvenile toad, and numerous tadpoles (> 150) were counted. An egg mass was observed at Cottonwood Spring that appeared to not be from the red-spotted toad, and speculation followed that these eggs may be from the canyon tree frog (*Hyla arenicolor*). A total of six additional tadpoles were counted at Flag Spring. Some of the tadpoles appeared to have tree frog characteristics. The Black Mountains, however, are outside the known range of the canyon tree frog, and the documentation of this species was not confirmed.

SURVEY CONCLUSION

The consensus of the survey group was that there appeared to be evidence of sufficient, permanent surface water and habitat to support a population of relict leopard frogs. There was also sufficient habitat outside of the private property boundaries to target for the actual introductions, although aquatic habitats on the private lands would eventually be colonized.

Figure 1.—The first large pool located at Cottonwood Spring (739128, 3883386, Zone 11, WGS84).
Tyler Colman commented that the water level was greatly reduced from January. Note the cement barrier on top of the rock face.

Figure 2.—Large pool where red-spotted toads were observed (pool is just above the barrier shown on figure 1).

Figure 3.—Pool below large dam at Cottonwood Spring (739182, 3883440, Zone 11, WGS84); the dam is visible in the background behind the cattails.

Figure 4—Large pools at Flag Spring (739782, 3884662, Zone 11, WGS84).
Note pipe drilled in rock with water pouring out.

Figure 5.—A deep, rocky pool located at Flag Spring (739793, 3884689, Zone 11, WGS84).